Session 2: Data Analytics - abstracts

Chair: Zümbül Atan

Stef Lemmens (Rotterdam School of Management)- Operational Challenges in Medical Transportation Platforms in Developing Countries

Many developing countries lack the health-emergency infrastructure of the developed world. In India and Bangladesh, for example, the average waiting time for an ambulance exceeds 40 minutes, in some cases reaching several hours. Consequently, many patients prefer to use taxis or rickshaws for medical transportation rather than rely on ambulances.

In this context, our industry partner Flare - operating in Nairobi, Kenya - coordinates existing ambulance providers by operating a platform. Flare and other similar platforms, like Dial4242 in India, aggregate the available ambulance capacity and demand for emergency services. The operators of these ambulance platforms have a variety of revenue models. For example, Flare charges users of the platform a subscription fee. Other platform revenue models include charging users and ambulance operators a fee per ride.

From an operational point of view, the main differences between ambulance platforms in developing countries and traditional ambulance services are information about the availability of ambulances and the capability to relocate ambulances. In traditional ambulance services, it is common to use the information about ambulance availability and location to relocate ambulances to address gaps in the coverage. In contrast, ambulance platforms in developing countries often lack the knowledge about all ambulances' availability and their location, and typically do not fully control these ambulances. These features increase the complexity of the optimal system operation.

Given this context and the data provided by Flare, our research questions are:

- What is the optimal relocation strategy if the platform has limited information on ambulances' availability and location?
- What is the benefit of knowing the current location and availability of part of the ambulance fleet?
- What is the benefit of having the opportunity to relocate part of the ambulance fleet?

Christina Imdahl (Eindhoven University of Technology) - Targeted Automation of Order Decisions Using Machine Learning

In many practical settings, a human reviews recommendations from a decision support algorithm and either approves or adjusts the recommendation. Adjustments can be rare when the algorithm is well-tuned to its task. However, humans must still review a potentially large number of recommendations, and an adjustment may not materially improve, and could even degrade, the original recommendation.

It may be possible to mitigate these inefficiencies with a machine learning (ML) classification model that is sufficiently effective at predicting human adjustments. Orders with a low predicted probability of receiving a value-enhancing adjustment can be automated or deprioritized for human review. A drawback of this approach is that automated or deprioritized reviews can weaken the ML model's learning and predictive performance over time due to censored human involvement.

We empirically examine the feasibility of predicting value-enhancing human adjustments, and how to overcome the deterioration that can ensue from automation. In our analysis, we employ four years of procurement ordering data from our research partner, a large materials handling equipment manufacturer. This data covers 502,551 supplier orders handled by 24 decision makers (planners).

We train and test a set of planner-level and pooled ML classifiers, and use them to identify a material portion of the order recommendations that can be automated. Using holdout data, we show that this saves the planners' time and improves part inventory positions by avoiding adverse planner adjustments. However, our results also demonstrate that automation reduces the system's longer-term ability to learn, and leads to predictive performance degradation over time. We introduce an optimization model to trade off the degree of automation with the predictive performance of the ML model.

Our analysis provides practitioners with insights for balancing the automation versus learning trade-off.

Ozge Tuncel (Eindhoven University of Technology) - Lower-Tier Supplier Sustainability Improvement Framework

Özge Tüncel, Stef Herrebout, Tarkan Tan

While the multinational companies have little influence on the lower-tier suppliers, they are held responsible for unsustainable actions of these suppliers by customers, NGOs and governments. The academic literature provides little guidance to companies on improving the sustainability levels of their lower-tier suppliers. By utilizing the available data on the first-tier suppliers, this project aims introduce a framework for lower-tier suppliers. The goal is to identify and motivate the best possible sustainability actions that can be taken by different types of suppliers without direct involvements of firms themselves. More specifically, we aim to introduce i) an automated system presenting a questionnaire depending on the supplier characteristics that can maximize their response potential and the value of the information provided, ii) a mechanism that can evaluate the data provided by the supplier to identify best methods to improve sustainability. To achieve this goal, we group the suppliers based on their characteristics using a multi-objective decision tree, assign a smaller questionnaire based on these characteristics using a sequential feature selection method, and predict sustainability levels of suppliers for 36 different aspects/levels of sustainability with a random forest algorithm, where we also allow the option to increase the accuracy of these scores with minimum effort from the firm. We are, furthermore, working on the methods to motivate different types of suppliers to follow the sustainability improvement recommendations presented.